SE EXTC Sem-4 10/06/2014

Signal and Systems.

QP Code :**NP-19845**

(3 Hours) **[Total Marks M.sc. : 80**

N.B. : (1) Question No. 1 is **compulsory**.
(2) Attempt any **three** from remaining **five** questions.
(3) Assume **suitable data** if **required** justify the **same**.

1. (a) Determine power and energy for the following signals. **20**

(i) $x(t) = 3 \cos 5 \Omega_0 t$.

(ii) $x[n] = \left(\frac{1}{4}\right)^n u[n]$

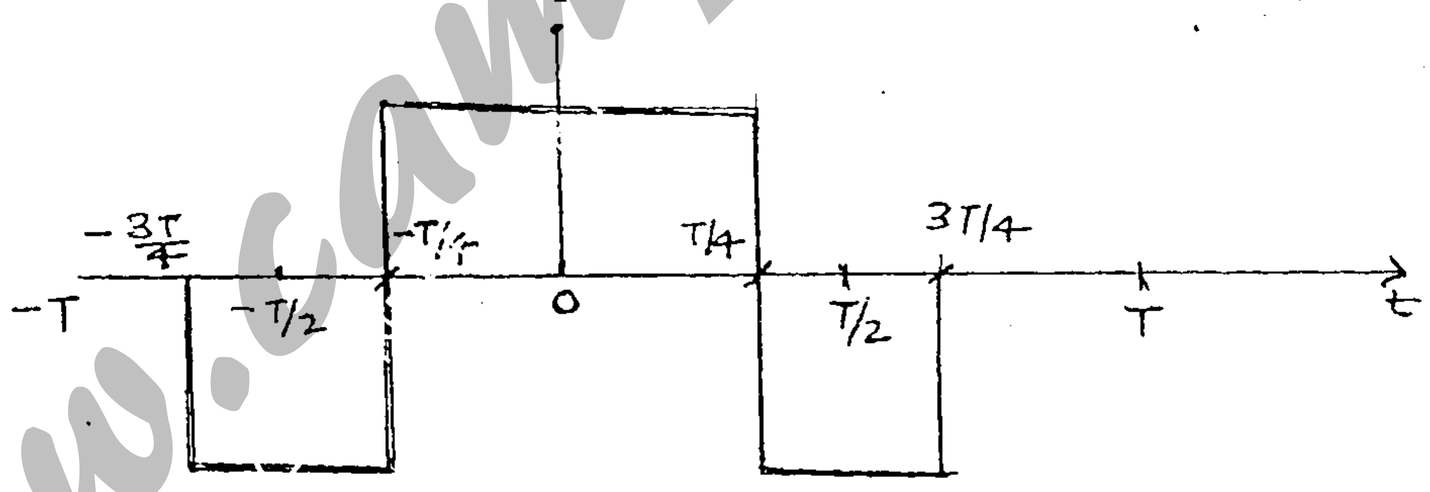
(b) State and prove the following properties of fourier transform :
(i) Time shifting property (ii) Convolution property.

(c) Compare linear convolution and circular convolution.

(d) Define and Explain :
(i) Auto correlation
(ii) Cross correlation
(iii) Circular convolution.

(e) $x[n] = u[n] - u[n-5]$.
Sketch even and odd parts of x[n].

2. (a) Determine Fourier Series representation of the following signal :— **10**



(b) For a continuous time signal $x(t) = 8 \cos 200 \pi t$. **10**
Find : (1) Minimum sampling rate.
(2) If $f_s = 400$ Hz, what is discrete time signal ?
(3) If $f_s = 150$ Hz, what is the discrete time signal ?
(4) Comment on result obtained in 2 and 3 with proper justification.

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3. (a) Determine the inverse z transform of the funciton using Residue method : **10**

$$X(z) = \frac{3 - 2z^{-1} + z^{-2}}{1 - 3z^{-1} + 2z^{-2}}$$

(b) Two LTI systems in cascade have impulse response $h_1[n]$ and $h_2[n]$ **10**

$$h_1[n] = (0{\cdot}9)^n\, u[n] - 0{\cdot}5\,(0{\cdot}9)^{n-1}\, u[n-1]$$

$$h_2[n] = (0{\cdot}5)^n\, u[n] - (0{\cdot}5)^{n-1}\, u[n-1]$$

find the equivalent response h[n] of the system.

4. (a) A causal LTI system is descrited $y[n] = \frac{3}{4}\, y[n-1] - \frac{1}{8}\, y[n-2] + x[n]$. **10**

Where y[n] response of the system and x[n] is excitation to the system.

(i) Determine impulse response of the system.

(ii) Determine step response of the system.

(iii) Plot pole-zero pattern and state whether system is stable.

(b) (i) Determine the z transform and the ROC of the discrete time signal. **5**

$$x[n] = \{\, 2,\ 10,\ 1,\ \underset{\uparrow}{2},\ 5,\ 7,\ 2 \,\}$$

(ii) Determine the inverse z-transform for the function : **5**

$$X[z] = \frac{z^2 + z}{z^2 - 2z + 1} \quad \text{ROC}\,|z| > 1$$

5. (a) The impulse response of an LTI system $h[n] = \{1, 2, 1, -1\}$. Find the response y[n] of the system for the input $x[n] = \{1, 2, 3, 1\}$ using Discrete time Fourier Transform. **10**

(b) Find the response of a system with transfer function $H(s) = \frac{1}{s+5}$ $R_e(s) > -5$ **10**

Input $x(t) = e^{-t}\, u(t) + e^{-2t}\, u(t)$

6. (a) For the given LTI system, described by the differential equation : **10**

$$\frac{dy^2(t)}{dt^2} + \frac{3dy(t)}{dt} + 2y(t) = x(t)$$

Calculate output y(t) if input $x(t) = e^{-3t}\, u(t)$ is applied to the system.

(b) Find the autocorrelation, power and power spectral density of the signal **10**

$x(t) = 3\ \text{cost} + 4\ \cos 3t.$

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